General

Guideline Title

Capnography guidelines.

Bibliographic Source(s)

Intensive Care Society. Capnography guidelines. London (UK): Intensive Care Society; 2011. 44 p. [100 references]

Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

Quality of evidence (high, moderate, low, very low) and grades of recommendation (strong, weak, no specific recommendation) are defined at the end of the "Major Recommendations" field.

1. *Capnography should be used for all critically ill patients during the procedures of tracheostomy or endotracheal intubation when performed in the intensive care unit (ICU).*
   Grade of recommendation: Strong

   Based on: A moderate level of evidence

   Advantages and disadvantages: Capnography reduces the risk of death and major disability as a result of airway misadventure. Capnography clearly does not remove the risk and, if incorrectly used, may contribute to the risk. The risk is relatively small for each patient but the negative outcomes would be catastrophic for the patient and relatives. For staff, there are additional major advantages in reducing the potential for a major complication associated with an intervention rather than an underlying disease process.

   Values and preferences: The lack of other major or minor side effects of the intervention makes it likely that patients would express a strong preference for the intervention.

   Economic evaluation: There has been no economic evaluation of the introduction of capnography.

2. *Capnography should be used in all critically ill patients during mechanical ventilation in the ICU.*
   Grade of recommendation: Although there is a lack of high quality comparative research, there is a wide clinical consensus that continuous capnography during mechanical ventilation should improve patient care. It is therefore the view of the Intensive Care Society, the Association of Anaesthetists and the Royal College of Anaesthetists that capnography should be used during mechanical ventilation in critical

care. Where capnography is introduced during mechanical ventilation in critical care this introduction should be carefully audited.

3. *Capnography should be used in all critically ill patients who require mechanical ventilation during inter-hospital or intra-hospital transfer.*
   Grade of recommendation: Strong

   Based on: The level of recommendation has been upgraded to strong based on the increased chances of airway misadventure during transfer and the difficulties associated with the diagnosis of tube misplacement in difficult clinical environments.

4. *Rare situations in which capnography is misleading can be reduced by increasing staff familiarity with the equipment, and by the use of bronchoscopy to confirm tube placement where the tube may be displaced but remains in the respiratory tract.*
   Grade of recommendation: Strong

Please refer to the original guideline document for additional uses of capnography in critical care that are based on strong evidence; however the nature of the recommendations does not make them suitable for the other aspects of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) classification.

Definitions:

Quality of Evidence

High = Further research is very unlikely to change the confidence in the estimate of effect.

Moderate = Further research is likely to have an important impact on the confidence in the estimate of effect and may change the estimate.

Low = Further research is very likely to have an important impact on the confidence in the estimate of effect and is likely to change the estimate.

Very Low = Any estimate of effect is very uncertain.

Strength of Recommendations

Strong recommendation: Most people in this situation would want this recommendation and only a small proportion would not.

Weak recommendation: Most people in this situation would want this intervention but many would not.

No specific recommendation: The advantages and disadvantages are equivalent.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Diseases or conditions requiring tracheostomy or endotracheal intubation in critical care settings

Guideline Category

Assessment of Therapeutic Effectiveness

Treatment

Clinical Specialty

Anesthesiology

Critical Care

Emergency Medicine

Surgery

Intended Users

Advanced Practice Nurses

Hospitals

Physician Assistants

Physicians

Respiratory Care Practitioners

Guideline Objective(s)

To provide recommendations on the use of capnography during intensive care

Target Population

Critically ill patients requiring tracheostomy or endotracheal intubation

Interventions and Practices Considered

Capnography use in intensive care unit (ICU) with the following procedures:

- Tracheostomy
- Endotracheal intubation
- Mechanical ventilation

Major Outcomes Considered

- Incidence and frequency of airway incidents
- Incidence and frequency of complications of tracheostomy or endotracheal intubation
- Airway associated cardiac arrest or deaths
- Airway associated morbidity (e.g., brain damage)
- Sensitivity, specificity, and reliability of capnography

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Search Strategies

The reviews have been conducted using the following search strategy, based on guidance issued by the Scottish Intercollegiate Guidelines Network guideline developers handbook (SIGN 50). The search time frame was February to August 2009 with an additional update in 2011. The update was not a systematic review but aimed to identify any new publications in a non-systematic way principally to include a major UK audit that had been conducted in 2011. The process includes the following steps:

1. Are there already evidence based literature reviews on the subject, for example: Cochrane collaborative reviews?
2. Are there previous systematic reviews or meta-analyses or are there trials registered in the Cochrane register of clinical trials?
3. If not, the literature was reviewed using specific subject headings in Medline, searching for Medical Subject Headings (MeSH) terms appearing in the titles or abstracts of papers. These terms are contained in Appendix 1 of the original guideline document. For some subjects all abstracts were reviewed. For others the search was initially limited to core journals, again, as listed in Appendix 1 of the original guideline document. For some subjects, all abstracts were reviewed. For others, the search was initially limited to core journals, again, as listed in Appendix 1 of the original guideline document.

It is well recognised that this technique of literature review will miss a considerable amount of relevant material. For this reason, the guideline authors used the Science Citation Index to identify papers that cited publications from the initial review. Additionally, publications were identified from the reference lists of papers identified in the initial review.

Publications were then included in the review if they were relevant to one of these specific questions:

1. Do airway incidents occur in critical care?
2. How common are they?
3. How commonly do patients suffer harm or potential harm?

These broad topic areas were further defined into the following review questions.

Literature Review Questions

i. *How commonly are airway incidents reported in general series of critical incidents that occur in intensive care*?
Reviews of all types of critical incidents occurring in critical care were identified to estimate how commonly airway incidents were reported. The search strategy is outlined in Appendix 1 of the original guideline document and a summary of the review is shown in Appendix 2, Table 1 of the original guideline document.

ii. *How common are incidents associated with percutaneous tracheostomy?*
Harm associated with tracheostomy has been systematically reviewed in preparation for the Trac-man study, and this is described in the trial protocol, the review estimated an interoperative mortality of 0.8%.

iii. *How common are incidents associated with endotracheal intubation?*
Reports of problems associated with endotracheal intubation in critical care were reviewed using the search terms set out in Appendix 1 of the original guideline document, while Appendix 2, Table 4 of the original guideline document, summarises the papers identified. More detailed information describing complication rates in different studies is contained in Appendix 2, Table 2 of the original guideline document.

iv. *How commonly do airway incidents occur after tube placement?*
    a. Unplanned extubation: The search strategy to review this literature is shown in Appendix 1 of the original guideline document and summary of publications are shown in Appendix 2, Table 2 of the original guideline document.
    b. Other incidents: Studies summarising rates and complications from blocked tubes are shown in Appendix 2, Table 3 of the original guideline document.

v. *Do airway incidents occur during intra hospital transport of critically ill patients?*
The search strategy is contained in Appendix 1 of the original guideline document and a summary of the identified papers is shown in Appendix 2, Table 5 of the original guideline document.

Evidence-based Reviews, Meta-analysis or Guidelines

The Cochrane review was searched to identify relevant controlled trials and guidelines and other meta-analysis previously recognised by the reviewers were also included.

Number of Source Documents

Not stated

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Quality of Evidence

High = Further research is very unlikely to change the confidence in the estimate of effect.

Moderate = Further research is likely to have an important impact on the confidence in the estimate of effect and may change the estimate.

Low = Further research is very likely to have an important impact on the confidence in the estimate of effect and is likely to change the estimate.

Very Low = Any estimate of effect is very uncertain.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Not stated

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The grading of the strength with which recommendations are made has been subject to detailed review. The development of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system to categorise the strength of evidence with which an intervention can be recommended is now commonly used.

The grade of recommendation is based on:

1. The quality of evidence (see the "Rating Scheme for the Strength of the Evidence" field)
2. The balance between the advantages and disadvantages of the recommendation. For capnography the advantages would include a reduction in the number of deaths associated with airway incidents whereas the disadvantages would include the potential for incorrect use of the equipment causing patient harm.
3. How patients would view the advantages and disadvantages of an intervention and balance the benefits and side-effects in reaching a preference
4. The economic and other costs of the intervention

Rating Scheme for the Strength of the Recommendations

Strength of Recommendations

Strong recommendation: Most people in this situation would want this recommendation and only a small proportion would not.

Weak recommendation: Most people in this situation would want this intervention but many would not.

No specific recommendation: The advantages and disadvantages are equivalent.

Cost Analysis

Opportunity Costs

Funds and training to develop capnography will divert activity from other areas of patient care. The estimated costs of introducing capnography across a healthcare system may be considerable. The guideline authors have not conducted a formal economic evaluation of the costs of introducing capnography into critical care; the costs would be highly dependent on the methods of airway humidification employed. The guideline authors reviewed costs in a 17 bedded mixed general and neurosciences intensive care unit (ICU) with established capnography where a mixture of active and passive humidification is used. For 5,788 patient days £9,500 were spent on disposables or replacement equipment for capnography during the financial year 2008/2009, most being spent on broken or lost cables. Future costs would also be dependent on the level of adoption of the technology, greater use reducing unit price; this means that an economic evaluation using current costs could significantly over estimate the true costs.

Method of Guideline Validation

Not stated

Description of Method of Guideline Validation

Not applicable

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for selected recommendations (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

- Appropriate use of capnography in critically ill patients requiring tracheostomy, endotracheal intubation or mechanical ventilation
- Reduction in the number of deaths associated with airway incidents

Potential Harms

- Opportunity costs. See the "Cost Analysis" field.
- Incorrect use of equipment. Misinterpretation of the relationship between end tidal carbon dioxide concentration ($_{ET}CO_2$) and arterial CO_2 could potentially leave patients hypercarbic. Misassembly of equipment could result in the misdiagnosis of an endotracheal tube placement as an oesophageal tube placement.
- Some small additional risks could be introduced. The weight of an inline capnograph and the additional connections added to the circuit could increase the risk of circuit disconnection while the electrical equipment could present a risk of burn or electrical injury. The Leur-lock connections used in side-stream capnography present a risk of misconnection.
- Other false positive and negative results. These are probably much less common in intensive care than in emergency medicine as emergency medicine patients are much more likely to be in cardiac arrest at the time of intubation. Although the wide spread introduction of

capnography into anaesthesia was associated with a reduction in airway associated mortality, clinicians cannot be sure this would be repeated in intensive care due to the differences in staff training and patient mix. Any potential risks associated with the introduction of capnography should be monitored using local incident reporting systems and by developing a national reporting system for patient safety incidents for critical care. This national system would establish how commonly airway incidents occur in UK critical care practice and how their frequency would be influenced by the adoption of routine capnography in critical care

Qualifying Statements

Qualifying Statements

Neither the Intensive Care Society nor the guideline authors accept any responsibility for any loss of or damage arising from actions or decisions based on the information contained within the original guideline publication. Ultimate responsibility for the treatment of patients and interpretation of the published material lies with the medical practitioner. The opinions expressed are those of the guideline authors and the inclusion in the original guideline publication of material relating to a particular product or method does not amount to an endorsement of its value, quality, or the claims made by its manufacturer.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Staying Healthy

IOM Domain

Effectiveness

Patient-centeredness

Safety

Identifying Information and Availability

Bibliographic Source(s)

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Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2011

Guideline Developer(s)

Intensive Care Society - Professional Association

Source(s) of Funding

Intensive Care Society

Guideline Committee

Standards Committee of the Intensive Care Society

Composition of Group That Authored the Guideline

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Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available from the Intensive Care Society Web site .

Availability of Companion Documents

None available

Patient Resources

None available

NGC Status

This summary was completed by ECRI Institute on June 13, 2013. The information was verified by the guideline developer on June 26, 2013.

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